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An Empirical Investigation into the Time-Use and Activity Patterns of Dual-Earner Couples With and Without Young Children

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An Empirical Investigation into the Time-Use and Activity Patterns of Dual-Earner Couples With and Without Young Children

by

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This thesis examines the time-use patterns of adults in dual-earner households with and without children as a function of several individual and household socio-demographics and employment characteristics. A disaggregate activity purpose classification including both in-home and out-of-home activity pursuits is used because of the travel demand relevance of out-of-home pursuits, as well as to examine both mobility-related and general time-use related social exclusion and time poverty issues. The study uses the Nested Multiple Discrete Continuous Extreme Value (MDCNEV) model, which recognizes that time-decisions entail the choice of participating in one or more activity purposes along with the amount of time to invest in each chosen activity purpose, and allows generic correlation structures to account for common unobserved factors that might impact the choice of multiple alternatives. The 2010 American Time Use Survey (ATUS) data is used for the empirical analysis. A major finding of the study is that the presence of a child in dual-earner households not only leads to a reduction in in-home activity participation but also a substantially larger decrease in out-of-home activity participation, suggesting a higher level of mobility-related social exclusion relative to overall time-use social exclusion. To summarize, the results in the thesis underscore the importance of re-designing work policies in the United States to facilitate a reduction in work-family conflict in dual-earner families.

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CHAPTER 1: INTRODUCTION

A fundamental difference between the traditional trip-based approach to travel demand modeling and the increasingly used activity-based approach to travel demand modeling is the way time is conceptualized and represented in the two approaches. In the trip-based approach, time is reduced to being simply a "cost" of making a trip. The activity-based approach, on the other hand, treats time as an all-encompassing continuous "tapestry" in which individuals "weave" their activity-travel participation decisions to form their daily activity-travel patterns. Thus, the basis of the activity-based approach is that individuals' travel patterns are a result of their time-use decisions. Not surprisingly, therefore, time-use research has taken the center stage in travel demand modeling in recent years. Of course, in addition to travel modeling, time-use research has been an interdisciplinary social science area of research to (a) examine and appreciate different cultures in the anthropology field, (b) understand the impact of urban form on time-use in the community and regional planning field, (c) investigate how much time individuals spend in physically active pursuits in the recreational science and public health fields, (d) explore gender roles and women's time-use patterns in the feminist economics field, and (e) consider work intensity issues (that is, measure work contribution not just in terms of work time, but also in terms of the number of different tasks handled per unit of time), and analyze the amounts of time individuals spend alone and interact with others (especially parents' time with children and children's time with new information technology devices) in the sociology and child development fields. Another field in which time-use has been receiving increasing attention lately is in happiness and well-being research, where the emphasis has been on time poverty (lack of time for leisure, sports, and relaxation activities) and social exclusion (broadly defined as the "inability to participate fully in society", one aspect of which is not being able to participate in the "normal activities of daily life"; see Farber *et al*., 2011).

Recently, attention has been drawn to the unique time-use patterns of, and time pressures faced by, members of households in which both spouses in couple and nuclear family households are employed. Numerous studies indicate that members of these dual-

earner households may face challenges in accommodating their many responsibilities into their daily schedules, while maintaining a sense of balance between their work and home lives. As such households become increasingly common in the U.S., Europe, and across the world, there is a need to examine their time-use and activity patterns, as well as associated issues of equity and marital and mental health. Also, from an activity-based travel demand modeling perspective, understanding the behavioral patterns of two-worker household members allows us to more accurately represent the daily decision-making processes of a large and growing segment of the population. Accordingly, the objective of this paper is to contribute to the relatively sparse, but expanding, body of research on examining the time-use patterns in work and non-work activities of individuals in dual-earner couple and nuclear family households (for conciseness, we will refer to such households simply as dual-earner households).[1]

1.1. Literature on Time Use in Dual-Earner Households

Dual-earner households constitute a significant fraction of households in the U.S. today. In particular, the percentage of households with a single breadwinner and with children (without children) has reduced from 52% (50.8%) in 1970 to 31% (25%) in 2010 (U.S. Census Bureau, 2011). This trend can primarily be attributed to an increase in the number of women entering the work force in recent years. For example, according to Boushey and Chapman (2009), 35% of married mothers stayed at home (no work outside) in the late 1970's, while this percentage has dropped to about 23% today. Overall, the rise in dual earner households has sparked academic interest in the social sciences regarding potential time poverty, social exclusion, and familial health issues of such households. While many different structuring mechanisms may be used to review the literature on time-use in dual earner households, we discuss this literature in three broad (and not necessarily mutually exclusive) areas: general time-use pattern analysis, gender inequity considerations, and quality of life issues. Each of these strands of research is discussed in

[1] A couple household, as referred to in the current paper, corresponds to two adults in a heterosexual marriage with no children, while a nuclear family household corresponds to two adults in a heterosexual marriage with children.

turn in the next three paragraphs. Following this review of the literature on time-use in dual earner households, we highlight literature on dual-earner households in the travel behavior field, underscoring their increasing relevance and providing a context for the current work.

In the area of general time-use pattern analysis, Allard and Janes (2008) descriptively examined patterns of daily time allocated to various activity purposes in dual-earner households, comparing trends in time-use by gender and the age of children in the household. In general, they observed that married men employed full-time (in the age group of 25-54 years of age) spend, on average, about an hour more at work on a workday than married working women employed full-time. Married working men employed full-time also spend, on average, about 0.5 hours more time on a workday in leisure and sports activities than married working women. Women, on the other hand, spend more time on childcare and household activities than men in nuclear family households, though the disparity decreases with the age of the children in the household. While reinforcing traditional stereotypical time-use patterns by gender, the study by Allard and Janes does not specifically tie these to gender inequity considerations, as do the second strand of research studies we discuss later. Voorpostel *et al.* (2010) specifically looked at joint leisure time trends of spouses over the past forty years, observing that, while the lives of individuals may have become busier, spouses do spend more of their social time in each other's company now than in the past. However, they also noted a decreased percentage of leisure time spent in the company of a spouse for dual-earner households compared to single-earner households. Focusing on dual-earner nuclear families, Ekert-Jaffé (2011) estimated the daily time costs of children of varying ages for parents. The study found that the time cost of three or more children is equivalent to a fulltime job. A number of other papers have provided similar broad and general descriptive analyses of the time use of individuals in dual-earner households (see, for example, Jacobs and Gerson, 2001 and Barnett *et al.*, 2009).

A second body of time-use research in dual-earner households has investigated gender inequity issues, examining disparities in time use patterns between men and

women and relating these to gender-based quality of life outcomes. Sociologists Arlie Hochschild and Anne Machung (1989) coined the term "the second shift" in their 1989 book on working parents. The second shift describes the additional time burdens and responsibilities of working mothers. Hochschild and Machung posit that working women are not only responsible for a daily shift of paid work, but also an additional shift of unpaid work in the home. Their research made the claim that working women spend roughly an additional month every year doing paid work, housework, and childcare compared to working men, indicating a greater time squeeze and consequent general lower quality of life for working women than their male counterparts. In response to Hochschild and Machung's work, Milkie *et al.* (2009) evaluated more recent and extensive time use data, and found that full time employed mothers, on average, spend an additional 1.5 weeks every year on total work than do their employed husbands. The measure of total work includes both market work (paid work time and commuting time) and non-market work (including housework, childcare, and shopping). Thus, while the disparity in "total work" time between working men and working women may not be as great as a full month every year as suggested by Hochschild and Machung (1989), there is still a clear time use gender gap. Numerous other studies have furthered the investigation into gender disparities in terms of time use and time poverty in dual-earner households (see Leonard, 2001, Deding and Lausten, 2011, Offer and Schneider, 2011). These studies generally confirm that women tend to spend more time on housework regardless of their employment status, leading to a greater time crunch on rejuvenating rest and relaxation activities relative to men. Furthermore, these studies have noted that working mothers spend more time multi-tasking than working fathers, and that working mothers perceive time spent multi-tasking more negatively. Some other studies have investigated differences between men's and women's time-use patterns after controlling for education levels, total household income, and occupational categories. For instance, Warren (2003) concluded that time use and task allocation vary both amongst spouses and across income groups. For example, women who hold manual labor jobs tend to spend longer hours on family care than women in professional jobs. Women and men in

higher-income occupations tend to have more similar wages to one another and a weaker sense of the male-breadwinner household structure than women and men in working-class households. Warren's study and other related studies identify variations across population segments in the time-use of men and women in dual-earner households, pointing out the importance of studying differential activity patterns by gender after controlling for other variables. This not only adds value to social and political analysis, but also allows us to more accurately model the daily behavior and decision-making of members of various demographic groups.

A third body of research has focused on overall quality of life considerations (such as time poverty effects, interaction time between family members, and temporal justice) of adults in dual-earner households, without necessarily focusing on gender-based considerations. This strand of research originates in the concern that the two-worker household structure deprives individuals of needed time for family and relaxation (regardless of gender) and has adverse effects on their quality of life. Several studies have linked the time crunch experienced by dual-earner households to a rising sense of work-family conflict (Hochschild, 1997, Nomaguchi, 2009, Tezli and Gauthier, 2009, Williams and Boushey, 2010, Goodin, 2010). These papers describe the struggle to balance work and home activities and responsibilities experienced in dual-earner households, regardless of income levels and occupational categories. For example, Williams and Boushey (2010) indicated that individuals who belong to low-income dual earner households tend to have more responsibilities for the care of family members and more irregular work hours. Middle-income dual earner households have experienced an increasing struggle to keep up with rising inflation levels since the 1960s. Middle-income workers also tend to have rigid work schedules and face difficulties in arranging childcare. Upper-income workers often work 50 or more hours per week, and feel pressured to stimulate their children's development to ensure future career prospects. Williams and Boushey conclude that Americans from all income groups would benefit from policies that address some of the causes of work-family conflict, such as paid sick days that can be used to care for sick children, childcare subsidies, and paid maternity leave. Wierda-Boer *et al.*

(2008) examined the determinants of perceived work-family balance, observing that an increase in an individual's paid work hours has a negative effect on his or her perception of work-family balance. Interestingly, an increase in a partner's paid work hours causes men to perceive an increase in work-family balance, but has a negative effect on women's perception of work-family balance. A few other studies have examined more specific quality of life effects. Strazdins *et al*. (2004) found an association between child difficulties and non-standard parent work hours. To be specific, the study found that many dual-earner parents attempt to manage their family schedules by working weekends, nights, or on-call or rotating shifts. However, children whose parents work during such non-standard hours are more likely to have emotional or behavioral difficulties such as hyperactivity, physical aggression, and separation anxiety. Nomaguchi *et al.* (2005) found that most dual-earner parents felt they spent inadequate time with their spouses, children, or by themselves. These adverse quality of life and familial health effects reinforce the relevance and importance of dual earner time use study.

In the travel behavior field, dual-earner households have gained attention in recent years. Maat & Timmermans (2009) found differences in the way single-earner and dual-earner households make commute mode choice decisions. Specifically, they found that residential location is the dominant factor that affects the decision of single-earner households to use a car or alternative mode to get to work, while the attributes of the work location also plays an important role in the commute mode choice decisions of the individuals in a dual-earner household. The study also found travel decision differences based on the presence or absence of young children in the household. Sultana (2006) points out the need to treat dual-earner households differently in residential location models, and in analyses of job-housing balances. She too highlights the inherent difference in commute choices for dual-earners, which are more likely to involve household interactions such as dropping off or picking up children during the commute. Van Ham & Hooimeijer (2009) reinforce the notion that dual-earner households make long- and medium-term decisions differently from single-earner households. They found

that dual-earners households are less likely to either move to a different residence or have a long commute (over 75 minutes, two ways). This effect is presumably because of the need to consider two job locations in residential choice and to consider household interactions in commute trips, which might limit members of dual-earner households from changing their residence once they have settled at a location that provides a manageable commute for both workers. These studies underscore both the differences in travel behavior (particularly in an activity-based travel demand model setting) and the possible mobility restrictions of dual-earner households.

1.2. Current Work in the Context of Earlier Literature

Much of the previous work has focused on time use of two-earner households in specific types of activities, such as work, childcare, housework, or leisure. In contrast, there has been relatively little work in examining the overall time use patterns of individuals in dual earner households across multiple activity purposes. Those that do investigate time use in multiple activity purposes typically do so in a descriptive manner with one or two exogenous variables. This research, on the other hand, analyzes overall daily time use and activity patterns using a disaggregate activity purpose classification and applies a multivariate analytic model that simultaneously considers multiple exogenous variables, with an emphasis on comparing households with and without young children while also accommodating the effects of several other household and individual socio-demographic characteristics. Furthermore, a distinction is made between in-home and out-of-home time investments in each of the activity purposes, because of the travel demand relevance of out-of-home pursuits, as well as to examine mobility-related social exclusion issues (in addition to general time-use social exclusion issues). Thus, our analysis adds value to both the social sciences literature and the transportation planning field.

The model used in the analysis is based on Bhat's (2005, 2008) Multiple Discrete Continuous Extreme Value (MDCEV) model, which recognizes that time-decisions entail the choice of participating in one or more activity purposes along with the amount of time to invest in each chosen activity purpose (see Habib and Miller, 2008, Xia *et al*., 2009,

Eluru *et al.,* 2010, Pinjari and Bhat, 2010, and Bhat *et al*., 2012 for applications of MDCEV and its variants in the time use context). The model can be embedded within an activity-based microsimulation platform to generate the activity-travel patterns of two-earner households, while considering the unique nature of the patterns of these households. The results from the model also can inform government and planning policy actions to promote work-life balance in the American work force.

The remainder of the paper is structured as follows. Section 2 discusses the data used and some key descriptive statistics. Section 3 briefly describes the Multiple Discrete Continuous Nested Extreme Value (MDCNEV) methodology used in our analysis. Section 4 presents the empirical findings. Section 5 finally concludes the study by summarizing important findings and identifying policy implications.

CHAPTER 2: DATA

The 2010 American Time Use Survey (ATUS) data collected by the U.S. Census Bureau under the sponsorship of the Bureau of Labor Statistics is used for the analysis in the current study. The 2010 ATUS data is the most recent nationwide time use data available and it includes detailed information on the amount of time spent by individuals in different activities throughout the day. The ATUS survey questionnaire was sent to households selected from the pool of households that completed the Current Population Survey (CPS).[2] The selection from the CPS was based on a stratified random sampling method to make the sample nationally representative. Furthermore, the ATUS data collection is randomized by day with half of the responses collected during weekdays and the remaining half on weekend days (Saturdays and Sundays). Thus, consistent with the recommendation of the ATUS user's guide, we applied weights during estimation to accommodate for sample biases (please refer to the ATUS user's guide (U.S. Bureau of Labor Statistics, 2012) for a description of the sampling and weight calculation procedures). The ATUS questionnaire was administered to a randomly selected civilian member at least 15 years old from each household using a computer-assisted telephone interviewing (CATI) procedure. In addition to the time-use information of the respondent, the survey also collected demographic information including age, gender, race, educational attainment, occupation, income, and marital status of all the members of the household. Accordingly, our analysis is undertaken at the individual level (*i.e.*, one working married adult per household) while controlling for the characteristics of the other working partner and children (if any) in the household.

The survey collected time use information at a very fine activity purpose level. For this study, we grouped these fine activity purposes into ten activity purposes: work, child-care (including playing and reading to children, travel related to child care, physical care, and other related child-care), and the following seven non-work activity purposes – personal care (including sleeping, grooming, and health-related self care), maintenance

[2] The CPS data is a monthly survey data of labor force information collected by the Bureau of Labor Statistics.

(including house cleaning, pet care, vehicle maintenance and repair, ATM and other banking, purchasing gas, quick stop for coffee/newspaper, visiting post office, and paying bills), social (including religious and spiritual activities, visiting relatives and friends, communicating with others, attending events, and parties and meetings), recreation (including relaxing, watching television, playing or listening to music, reading, writing, enjoying nature, and non-competitive activities such as hiking, walking around the neighborhood, pleasure boating and camping), physical exercise and activity (including active outdoor sports, exercise, going to a gym, practicing yoga, and exercising in-home), eating, shopping (including all purchases and rentals of consumer goods such as clothes and grocery), and travel. The activity purposes considered are exhaustive and mutually exclusive, covering all the activities that an individual can pursue in any given day. Thus, the time investments in these activity purposes in one complete day add up to 1440 minutes. Also, in this study, a distinction is made between in-home and out-of-home time durations in each of the activity purposes. This leads to a total of 20 alternatives (activity purpose and location combinations) However, we found that there were very few respondents participating in shopping activity purpose in-home, and personal care activity purpose out-of-home. Also, by definition, the "travel" activity purpose is out-of-home. Thus, we ultimately considered 17 alternatives in our analysis.[3] The dependent variables in our model system are the amounts of time invested in each of these 17 alternatives (including no participation or zero time investment in one or more of these 17 alternatives).

A total of 2468 respondents in the ATUS sample belong to our target group of individuals in dual earner households.[4] After deleting records with missing information, the number of respondents reduced to 1545. However, we verified that the distribution of demographic variables such as education levels, race, ethnicity, geographic distribution in the US, and employment industry were about the same in the weighted final sample of

[3] The two alternatives corresponding to the child care activity purpose do not appear in the choice set of respondents without children.

[4] In our analysis, we considered only respondents who were 20 years or older, to focus efforts on those who have relatively stable jobs and stable household settings.

1545 respondents and the original sample of 2468 respondents. Table 1 provides descriptive statistics of the dependent variables of interest for the final sample used in the analysis. Specifically, the table provides the percentage of respondents participating in each alternative (activity purpose and location combination) and the mean duration of participation among those who participate in each alternative, categorized by whether there are children present or not in the respondent's household. The percentage of respondents participating in child care is zero for households
without children, for obvious reasons.[5]

Several observations may be made from Table 1. First, all respondents invested some amount of time during the survey day in the personal care alternative (see the last row of the table). Thus, we specify this alternative as the outside alternative (*i.e.*, the alternative that is always consumed) in our model. Second, a high percentage of respondents participate in maintenance, recreation, and eating activity purposes in-home. Further, more than one-fifth of respondents pursue work activities from home, with a mean duration of over two hours (see the first numeric row of Table 1). This is likely a reflection of the penetration of personal computers and broadband internet connectivity within homes, which contributes to a looser demarcation between the work place and home for work activity. Third, as expected, a very large percentage of individuals pursue some travel activity during the day, with the mean duration of time spent on traveling being slightly shy of an hour and a half (see the penultimate row of Table 1). There is also a reasonably high percentage of respondents who work and eat out-of-home during the survey day. Fourth, there is not much difference in the percentage of respondents participating in each alternative (except the child care alternatives) across households with and without children. However, the mean duration in social and recreation activity purposes (both in-home and out-of-home) is clearly lower in respondents from

[5] If we focused only on weekdays, and if all the employed individuals actually worked on the survey day, the sum of the entries under the in-home and out-of-home location categories for work should sum to 100 or more (to allow the possibility that individuals can work in-home as well as out-of-home on the day they work). However, the sum of these entries is less than 100 in the table because we include weekend days in the analysis.

households with children. On the other hand, there is literally no difference in the mean duration for work activity between respondents in households with and without children. These results are a manifestation of the time poverty among individuals in households with children. Specifically, individuals in households with children tend to work for about the same time as those without children, and then have to undertake some level of child care activities, which takes away from social and recreational time investments.

A final note about the sample (not based on the statistics in Table 1). None of the sample respondents participated in only personal care; rather, all respondents participated in personal care and at least one more alternative. This illustrates the classic multiple discrete nature of the problem, necessitating a modeling framework that can account for the consumption of multiple alternatives simultaneously (Bhat *et al*., 2012).

CHAPTER 3: METHODOLOGY

Let t_k be the time invested in alternative k (k = 1, 2, …, K), where k is an index for the alternatives represented by the combination of activity purpose and location. Without loss of generality, we will assume that the first alternative (k = 1) represents the in-home personal care alternative. Consider the following additive, non-linear, functional form to represent the utility accrued by an individual through time investment in the various alternatives:[6]

$$U(\boldsymbol{t}) = \psi_1 \ln(t_1) + \sum_{k=2}^{K} \gamma_k \psi_k \ln\left(\frac{t_k}{\gamma_k} + 1\right) \quad (1)$$

The term ψ_k represents the random marginal utility of one unit of time investment in alternative k at the point of zero time investment for the alternative. Thus, ψ_k basically controls the discrete choice participation decision in alternative k (though it also impacts the duration of participation, with smaller values of ψ_k translating to lower participation durations, everything else being the same). We will refer to the ψ_k term as the baseline preference for alternative k. In the above utility function, the impact of exogenous variables may be conveniently introduced through the ψ_k parameters as

$$\psi_k = \exp(V_k + \varepsilon_k) = \exp(\boldsymbol{\beta}'\boldsymbol{z}_k + \varepsilon_k) \quad (2)$$

where, $\boldsymbol{z}_k$ is a vector of exogenous determinants (including a constant) specific to alternative k (there is no such vector for the first alternative because only differences in utilities matter, so $\psi_1 = \varepsilon_1$), and ε_k captures unobserved factors that impact the baseline utility for good k. The γ_k terms in Equation (1) are translation parameters which serve two roles. First, they allow corner solutions for the consumer demand problem, *i.e.*, they allow for the possibility that the individual may not choose certain alternatives, as is the case for all alternatives in our analysis except the in-home personal care alternative. Secondly, they serve the role of satiation parameters, *i.e.*, they

[6] Several other additive, non-linear, utility forms, as proposed by Bhat (2008), were also considered. However, the one provided below was the best form in the empirical analysis of the current paper.

reduce the marginal utility accrued from investing increased amounts of time in any alternative. Specifically, values of γ_k closer to zero imply higher satiation effects (*i.e.*, lower investments) in activity k (see Bhat, 2008). The γ_k parameters can be parameterized to be a function of covariates as $\gamma_k = \exp(\boldsymbol{\lambda}_k' \boldsymbol{w}_k)$ where $\boldsymbol{w}_k$ is a vector of covariates (including a constant). Such a specification accommodates variations in satiation across respondents.

From the analyst's perspective, individuals are maximizing random utility $U(\boldsymbol{t})$ subject to the time budget constraint that $\sum_k t_k = T$, where T is the total time available in the day which is equal to 1440 minutes. The optimal time investments t_k^* (k = 1, 2, ..., K) can be found by forming the Lagrangian function (corresponding to the problem of maximizing random utility $U(\boldsymbol{t})$ under the time budget constraint T) and applying the Kuhn-Tucker (KT) conditions. After extensive, but straightforward, algebraic manipulations, the KT conditions collapse to (see Bhat, 2008):

$V_k + \varepsilon_k = V_1 + \varepsilon_1$ if $t_k^* > 0$ ($k = 2, 3, \ldots, K$)

$V_k + \varepsilon_k < V_1 + \varepsilon_1$ if $t_k^* = 0$ ($k = 2, 3, \ldots, K$), where (3)

$$V_1 = \beta' z_1 - \ln(t_1) \text{ and } V_k = \beta' z_k - \ln\left(\frac{t_k}{\gamma_k} + 1\right) \ (k = 2, 3, \ldots, K) \quad (4)$$

The joint probability expression of time investment patterns is dependent on the joint cumulative distribution $F(\varepsilon_1, \varepsilon_2, ..., \varepsilon_K)$ of the error terms $(\varepsilon_1, \varepsilon_2, ..., \varepsilon_K)$. If these error terms are assumed to be independently and identically distributed across alternatives, the result is the MDCEV model. However, we expect some dependence among the error terms of the different alternatives. For instance, individuals who are generally more sociable by nature are likely to have a higher baseline preference for both the in-home and out-of-home social activity purposes, generating a correlation between these two alternatives. Similarly, individuals who intrinsically prefer to pursue activities in-home may be more likely, than their observationally equivalent peers, to pursue all activity purposes in-home. This would generate a correlation in the error terms across all

alternatives that share the in-home location. To allow for such correlation structures, we use a nested extreme value (NEV) distribution for the error terms, which results in the multiple discrete continuous nested extreme value (MDCNEV) model. The reader is referred to Pinjari and Bhat (2010) for the probability expression for the MDCNEV model

CHAPTER 4: ESTIMATION RESULTS

4.1. Variables Considered

We considered several household, respondent, and spouse demographic and employment variables in our variable specification effort. Specifically, we included: (1) household socio-demographics (presence of children by age group, housing tenure, an indicator variable for whether the household resides in a metropolitan area or not, and the geographic location of the household in the U.S.),[7] (2) respondent socio-demographics (age, gender, race/ethnicity, educational attainment, immigration status, employment industry, an indicator for a single job versus multiple jobs, and weekly wages), (3) couple characteristics (spouse socio-demographics as well as variables constructed using both the respondent and spouse characteristics, and (4) day of week (weekday *versus* weekend). Although the study would benefit by considering spatial variables characterizing the activity-travel environment (ATE) around household locations (such as land use, demographic composition, and accessibility measures), we are unable to do so because the ATUS dataset does not provide the geographic coordinates of respondent households.

The next section discusses the estimation results of the MDCNEV model, while Section 4.3 discuses model fit.

4.2. Estimation Results

The estimation results of the best specification of the MDCNEV model are presented in Tables 2a (for the baseline utility specification) and 2b (for the satiation parameter specification). As discussed earlier, the "personal care" alternative is the outside good in which all respondents invest a non-zero amount of time. This alternative serves as the base alternative with respect to which the baseline utilities of all the remaining

[7] We did not include household income in our analysis because it was missing for many observations in the sample. We instead used weekly wages of the respondent and the spouse. Also, the ATUS survey did not collect mobility-related information such as bicycle and car ownership. So, we are unable to consider these variables in our analysis. Even if these were available, it is likely that these variables are endogenous to time-use patterns. For instance, it is possible that individuals decide on their vehicle ownership based on preferences for investing time in-home versus out-of-home.

alternatives are specified. A '--' entry corresponding to the effect of a variable for a particular alternative in Table 2 indicates that the variable has no significant differential effect on the corresponding alternative's utility (relative to the utility of the personal care in-home alternative). Also, if the model coefficients are the same across alternatives for a specific variable, this is because no statistically significant differences were found in the effect of the variable across the utilities of the corresponding alternatives. Similarly, if the coefficients are the same across exogenous variables for a specific alternative, this is because no significant differences were found in the effects of the variables on the alternative's utility (relative to the utility of the personal care in-home alternative).

The estimation results for the baseline utility specification are discussed under four categories of variables: household socio-demographics, respondent socio-demographics, couple characteristics, and day of week. Interaction effects between the respondent and household attributes are discussed with the main effects under the household socio-demographics category of variables.

4.2.1 Effects of Household Socio-Demographics on Baseline Utility

Among the household socio-demographic variables, we explored the impact of children in the household using dummy variables for the presence of children in several specified age groups as well as the number of children in the age groups. The best specification turned out to be the one that included variables corresponding to the presence of children in three age groups: 0-5 years, 6-10 years, and 11-15 years. Table 2 indicates that respondents with children older than 5 years have a lower baseline preference for in-home work activity relative to those without children (note that, by construction, all respondents in the sample are employed; the interpretation of the lower baseline preference for in-home work is that, other things being equal, respondents with children older than 5 years have a lower baseline preference to pursue in-home work on any given day than respondents without children). However, we did not find evidence for such differences between respondents with and without children for out-of-home work activities. The results also demonstrate the high propensity for investing time in in-home

child care when there are young children (0-5 years of age) in the household, perhaps reflecting a general preference for personally (and in the comfort and privacy of the home) meeting the biological needs of young children (see Farkas *et al*., 2000 for a similar result). This predisposition for in-home child care is particularly strong for mothers, as can be observed from the positive coefficients (specific to the in-home child care alternative) on the female variable interacted with the presence of children. Not entirely surprisingly, the inclination to invest time in in-home child care activities disappears for fathers, and mothers over the age of 45 years, in households with children in the age group 6-10 years (with no children in the 0-5 years age group), as can be noted by the absence of a coefficient corresponding to the presence of children in the 6-10 years age group for the in-home child care alternative. However, the inclination for in-home child care still exists for mothers 45 years or younger with children in the age group 6-10 years (due to the positive coefficients on the "female $\leq$ 30 years" and "female 31-45 years" variables interacted with the presence of children). Additionally, the results indicate that mothers aged over 45 years, and particularly fathers, with only older children (11-15 years of age) are less likely to spend time with children in-home and more likely to spend time with children out-of-home. Also, mothers of all age groups are more likely to invest time taking care of children outside the home compared to fathers, just as in the case of in-home child care activities.

An important result, which is of direct relevance to this study, is that respondents in households with children of any age group are less likely (than respondents in households without children) to invest time in out-of-home maintenance, social, recreational, physical, and eating activities. In addition, employed parents with young children (0-5 years of age) are quite unlikely to participate in in-home recreational and physical activities, as indicated by the relatively large negative coefficients corresponding to the "presence of children 0-5 years" variable for these two activities. Overall, the additional child care responsibilities coupled with work commitments is negatively affecting the participation of working parents in social, recreational, and physical activities. This is consistent with our hypothesis that employed parents with children are

prone to time poverty (lack of time for leisure, sports, and relaxation activities) and social exclusion, echoing the high time cost of children found by Ekert-Jaffe (2011) and the time crunch experienced by dual-earner parents found by Deding and Lausten (2011). However, respondents in households with children less than 5 years are more likely to go out shopping, perhaps as a way of breaking the monotony from work and child care activities, and/or to meet the basic biological and other needs of young children (such as purchasing baby food, diapers, and clothes).

Among other household socio-demographic variables, respondents residing in metropolitan areas have a lower baseline preference for out-of-home social activities compared to respondents in non-metropolitan areas. This is an interesting result that presumably is suggesting an urban culture that is moving away from the relatively close-knit, informal, and social networks that still exist in non-urban areas for visiting and related social get-togethers (for instance, see Romans (2011) who examines differences between urban and non-urban communal structures and points out this "social separation" in urban areas relative to non-urban areas, and Coleman (2009) who examines modern social activity trends and isolation in urban areas). Finally, within the group of household socio-demographics, respondents geographically located in the south of the U.S. have a lower participation propensity in in-home physical activities and a higher participation propensity in out-of-home eating activities compared to respondents located elsewhere in the nation. These coefficients are capturing the average tendencies of respondents in different areas due to factors unaccounted for in our empirical analysis, and do not have substantive interpretations.

4.2.2 Effects of Respondent Socio-Demographics on Baseline Utility

Several respondent age and gender interaction effects turned out to be statistically significant in the final specification. The results reveal that employed women are less likely to participate in out-of-home work on any given day compared to employed men. Also, women are much more likely to undertake maintenance (both in-home and out-of-home) and out-of-home shopping activities, reinforcing the stereotype of women

assuming the responsibility or burden of household chores (see Leonard, 2001, Parkman, 2004, Srinivasan and Bhat, 2005, Braun *et al*., 2008, and Sayer and Fine, 2011 for a similar result). At the same time, and perhaps in part because of the time investment in maintenance and shopping activities, women participate less in in-home recreational and physical activities (in-home as well as out-of-home), as indicated by the negative coefficients corresponding to the female variable for these alternatives. However, men over 45 years of age take the top spot in terms of participating the least in physically active in-home activities. The results also point out that women (and particularly young women 30 years or younger) participate more in out-of-home social activities compared to men, a result that has been consistently found in the literature and attributed to women intrinsically being more sociable than men (see Feingold, 1998, Envick and Langford, 2003, Siegling *et al*., 2012, and Kapur and Bhat, 2007). Thus, out-of-home socializing may be appealing to women as a means to relax after pursuing work and household maintenance activities. A similar reason may be behind the higher propensity of women 30 years or younger (relative to men and women over 30 years) to participate in eating out activity. On the other hand, men over 45 years of age are positively predisposed to in-home eating activities.

The race variable effects indicate that, relative to non-Caucasian and non-African American races (including Asian, American Indian, and mixed races, but dominated by the Asian race), Caucasians and, in particular, African Americans are less likely to participate in in-home child care and in-home eat and drink activities. Such race-related differences in caring for children and eating-in have been found in earlier cultural studies (see for example Yee *et al*., 2007, Cluskey *et al*., 2008, Jang, 2002, and Neumark-Sztainer *et al*., 2003, 2010), some of which attribute these differences to Asian families tending to have more of a collective as opposed to an individualistic mindset, and being more cohesive as a family unit and investing more time together in in-home family activities. African American families also appear to participate less in in-home maintenance and out-of-home eating activities. The ethnicity variable effect reveals the lower baseline preference for in-home work and child care activities among Hispanic

respondents relative to non-Hispanic respondents. Further research is needed to understand the cultural and other underlying reasons for these race- and ethnicity-based differences.

Moving next to the education variables, respondents with high educational attainment (bachelor degree or higher) are less likely to undertake out-of-home work on any given day, relative to respondents with low educational attainment (not obtained a bachelor degree). This is consistent with the finding from several earlier telecommuting studies (see, for example, Singh *et al.*, 2012, Golden, 2008, and Turcotte, 2010) that higher educated individuals hold more negotiating ability in retaining the option to work from home. In addition, respondents with a degree beyond high school participate less in in-home recreation, and those with advanced degrees (Masters or beyond) also participate less in out-of-home recreation and eat-out activities. Kapur and Bhat (2007) have also noted the decreased participation of highly educated individuals in in-home recreation, suggesting that those with high educational levels usually have high opportunity costs of time and view investment in in-home recreational activities (such as watching TV, and playing computer games) as lost time (see also Leibowitz, 1975).

The finding from Table 2 that individuals with multiple jobs have a higher propensity (relative to individuals with a single job) of working from home is quite intuitive, given that people with multiple jobs typically have home as the work place for one of their jobs (Khan *et al.*, 2012). Individuals employed in the construction sector, armed forces, and financial sector (in that order) are less likely to participate in in-home work (compared to employees in other industries). This is consistent with the general notion that jobs in these fields require employees to be present at the work place.

Immigration status has an impact on the time investment decisions of the respondent, even after controlling for other demographic variables. Specifically, foreign born (both citizens and non-citizens) respondents are less inclined to participate in out-of-home social activities compared to U.S. born respondents. Also, non-citizens have a lower propensity of participation in in-home recreational and out-of-home physical activities compared to foreign born citizens and U.S. born respondents. Differences

between the tastes and preferences of immigrants and U.S. born people have been observed in the past in the context of residential location, work arrangement, and vehicle ownership choices (see Khan *et al.*, 2012 and Singh *et al.*, 2012). Similar to the race/ethnicity variables, further research is needed to investigate the reasons for these differences between immigrants and non-immigrants. Until then, the results obtained in this study underscore the importance of considering immigration status variables in time-use studies, an issue that has not received much attention as it deserves.

4.2.3 Effects of Couple Characteristics on Baseline Utility

The effects of couple characteristics indicate the following: (1) A respondent with a spouse who has a degree beyond high school is more likely (than a respondent with a spouse who has completed high school or less) to undertake in-home work, (2) A respondent from an all-Hispanic household has a lower baseline preference for in-home work activities relative to a respondent from other household race combinations, (3) A respondent from a household where both the husband and wife are less than 30 years old is less inclined to partake in in-home maintenance activities compared to a respondent from other households (presumably because of fewer household maintenance obligations in such households), (4) A respondent with a substantial age separation from her/his spouse is less likely to participate in in-home work relative to a respondent who is close in age to her/his spouse, and (5) A respondent who earns less than his/her spouse is less likely to work in-home. Additional investigations through focus groups and other in-depth qualitative survey techniques are needed to tease out the underlying reasons for these effects.

4.2.4 Day of the Week Effects on Baseline Utility

As expected, respondents are least likely to work (both in-home and out-of-home) on weekends. Also, respondents have a lower propensity during the weekends to participate in child care activities (presumably because of turn-taking in the parental role) and are less inclined to participate in non-social out-of-home activities compared to in-home

activities and out-of-home social activities. In summary, over the weekends, individuals appear to prefer to pursue rest, recreation, and relaxation activities in-home with their families, and/or social activities, relative to non-social out-of-home pursuits (Agarwal, 2004).

4.2.5 Baseline Preference Constants

Personal care activity is treated as the base alternative. Negative coefficients on the alternative-specific constants suggest that the participation levels of respondents in other alternatives are lower than in the personal care alternative. This is expected since all respondents in the sample invest some non-zero time in the personal care alternative. Given that there are many continuous variables in the baseline utility specification, the baseline constants cannot be directly compared across the non-personal care alternatives. However, the relative magnitude of constants on the alternatives indicate that respondents are least likely to invest time in in-home physical activities (the most negative baseline constant), while they are most likely to participate in travel and recreational activities in-home. These results are consistent with the low participation rate in in-home physical activities (about 8% for households without children, and 4.5% for households with children) and the high participation rate in in-home recreational activities (about 88% for households without children and 83% for households with children), as reported in Table 1.

4.2.6 Translation (γ_k) Parameters

As mentioned earlier, the translation parameters γ_k $(k = 2, 3, ..., K)$ control the duration of time investment in the alternative *k* (note that we do not estimate a γ_k parameter for the personal care alternative because all individuals invest some non-zero time in this alternative). γ_k values closer to zero imply higher satiation effects (*i.e.*, lower investments) in alternative *k*. Also, as discussed in the methodology section, γ_k can be parameterized as $\gamma_k = \exp(\boldsymbol{\lambda}_k' \boldsymbol{w}_k)$ to allow for the satiation effects to vary across

respondents.

The λ_k parameter estimates and the corresponding t-statistics are provided in Table 3. In our analysis, we found several significant heterogeneity effects in the satiation of alternatives across the respondents. First, women 30 years or younger have the highest satiation (lowest duration of participation) in in-home work activities, while men older than 45 years have the lowest satiation (highest duration) in in-home work activities. Second, women beyond the age of 45 years tend to invest more amounts of time in caring for children outside the home and in shopping activities compared to other women and men. The result for shopping, when combined with that from the baseline utility function in Table 4a, suggests that not only are women older than 45 years of age more likely to participate in shopping activities, but they also partake in these activities for longer durations when they participate. Third, men above the age of 30 years spend very short durations of time in out-of-home social activities compared to younger men (30 years or younger) and women. Taken in concert with the baseline utility results, the implication is that men are much less likely compared to women to participate in out-of-social activity pursuits and, when they do so, participate for much less time than women (except for young men less than 30 years of age). Fourth, men older than 45 years of age have low durations of participation in out-of-home recreation and in-home eating pursuits. Fifth, women with children spend short durations of time in out-of-home maintenance pursuits, while men with children spend short durations in out-of-home recreation pursuits. Clearly, these results indicate the importance of capturing heterogeneity across individuals not only in participation rates, but also in duration amounts.

The constant values in Table 3 indicate that that out-of-home work activities have the least satiation, consistent with the long mean duration of investment (478 minutes) in out of-home work activity when participated in (see Table 1). On the other hand, in-home eating has the highest satiation, consistent with the short mean duration of investment (47 minutes) in this activity.

4.2.7 Nesting (θ) Parameters

We considered several nesting structures during model estimations. But the best specification from a data fit and consistency perspective was obtained with the nesting structure that included a single nest with all out-of-home alternatives. The estimated nesting parameter was 0.5135 (with a t-statistic of 38.06).[8] This indicates that there are unobserved factors (such as individual preferences to pursue activities out-of-home, or environment and social vibrancy considerations) that uniformly increase the utility of out-of-home participations across all activity purposes

4.3. Goodness of Fit Measures

The log-likelihood of the final MDCNEV model is -70613.1. On the other hand, the log-likelihood of the MDCEV model with only constants in both the baseline utility function and γ_k specification is -72783.4. It is obvious that the MDCNEV model outperforms the constants-only MDCEV model, based on a likelihood ratio test (the likelihood ratio test value is 4340.51, which is larger than the corresponding chi-squared table value with 71 degrees of freedom at any reasonable level of significance). This indicates the explanatory power of the estimated MDCNEV model. We also estimated another MDCEV model with all explanatory variables, but without the nesting. The log-likelihood of this MDCEV model is -71253.5. The likelihood ratio test value for the presence of nesting is 1280.77, which is much larger than the chi-squared value with one degree of freedom at any reasonable level of significance.

4.4. Magnitude Effects of Variables

The estimated model parameters do not directly provide an estimate of the magnitude of variable effects on time investments in the many activity purpose-location combination alternatives. To do so, we can compute the effects of variables by forecasting the time-use patterns before and after a change in the variables, and computing a percentage

[8] The t-statistic for the nesting parameter is reported with respect to a value of 1.

change for each activity purpose-location alternative. However, because of the non-linear structure of the model, these effects will vary for each respondent. So, in this study, we compute an aggregate percentage change across the entire sample. Further, to keep the presentation focused, we demonstrate the effect of a change in a single variable corresponding to the "presence of children 0-5 years old". To do so, we first forecast the duration of time investment in all the alternatives for each respondent in the estimation sample, assuming the absence of children for all respondents). The forecasting algorithm of Pinjari and Bhat (2011) is employed in the forecasting exercise, using 100 sets of error term draws for each respondent.[9] Once the time investments for all alternatives are forecasted, these are averaged across all respondents (and also separately for men and women) by alternative. Next, we change the dummy variable corresponding to the child age category of 0-5 years from the value of "0" to "1" for each record in the estimation. After this change, the forecasting algorithm of Pinjari and Bhat (2011) is applied again to obtain new time investment forecasts averaged again across all respondents (and separately for men and women). The effect of the presence of a child 0-5 years of age is then computed by taking the percentage difference in the time investment forecasts averaged across all respondents (and separately by men and women) from after the change to before the change. These percentage changes by alternative will be referred to as elasticity effects in the rest of this study, although these percentage changes are based on a change in dummy variables. Lastly, we also compute the standard errors of the elasticity effects by using 100 bootstrap draws from the sampling distributions of the estimated parameters. We compute the t-statistic using these standard errors to see if the elasticity values are significantly different from zero.

Table 4 presents the elasticity results and the corresponding t-statistic values. The numerical values in the first row of the table may be interpreted as follows. The presence of a child five years of age or younger in a typical dual-earner household (1) decreases the time spent in in-home work activity by about 1% for the parent of the child, (2)

[9] In this paper, we used the one factor multivariate extreme value method to simulate the nested extreme value (NEV) error term draws (see McFadden, 1995 and Cameron and Kim, 2001). Alternatively, one could also use the Laplace Transforms method proposed in McNeil *et al.* (2005).

increases the time spent in in-home work activity by 1.4% for the father of the child, and (3) decreases the time spent in in-home work activity by 3.9% for the mother of the child. However, the percentage changes in the time spent in in-home work activities are not significantly different from zero at the 5% level of significance in the overall as well as for both parents of the child (as indicated by the very low t-statistic values in the first numeric row of Table 4). Other entries in the table may be similarly interpreted.[10] The table does not have the "Child Care" alternative because the elasticity effect for this alternative would be infinity (since there is no time invested in child care in the base scenario when there are no children).

The results in Table 4 are quite remarkable in that they show decreases in all non-work activities (both in-home as well as out-of-home) except shopping activity (as indicated earlier, the increase in shopping activity may be a reflection of a conscious effort to step out of the home to get some "air" or simply a result of increased shopping needs related to the young child). There is clear evidence that individuals with children are continuing to invest about the same time in in-home and out-of-home work activities as individuals without children, as indicated by the low elasticity values in the first two numeric rows of Table 4. Indeed, the t-statistic values corresponding to in-home and out-of-home work are well below the 5% level of significance, except for mothers in out-of-home work activity. These low elasticity effects of the presence of children on work activity also reinforces the notion of Williams and Boushey (2010) that "the United States today has the most family-hostile public policy in the developed world." While one could argue that the lack of a change in work times between individuals with and without children, as found in our study, is simply a reflection of individuals with children making

[10] There is no effect of the presence of children 5 years or younger on the baseline preference or satiation for the in-home work alternative in the estimation results in Table 2. However, the small decrease in the percentage of in-home work duration for mothers with children 5 years or younger is due to the time invested in child care responsibilities, which takes away from the overall time available and reduces in-home work time too (this is discernible in Table 2 in the positive coefficients on the baseline utility for child care activities corresponding to the presence of children 5 years or younger and the female variables). On the other hand, the small increase in the percentage of in-home work duration for fathers with children 5 years or younger in Table 4 is because fathers aged more than 45 years (who constitute nearly 36% of the fathers in the sample) have the lowest satiation for in-home work activities (although the percentage increase is not significantly different from zero).

the deliberate choice of not cutting back on work activity (say because they enjoy their work immensely), it is quite likely that a major contributor to this phenomenon is that individuals in the U.S. do not have too many options to cut back on work activity even if they want to. Of course, one could reason that working for pay (or not) is simply a personal choice and one could always decide not to work. But the very fact that the share of dual-earner households has risen in the past few decades, even as individuals report an increase in work-family conflict that they do not enjoy (see, for example, Nomaguchi, 2009), is adequate evidence of families needing the market pay to retain a sense of financial security. Thus, the social debate must shift from whether or not work is a matter of personal choice to one of how to facilitate a reduction in work-family conflict through family-friendly work policies. And for those "responsibility for choice" commentators who might argue that there is no need for such policies and regulations since dual-earner families have the choice of not having children at all as a means to reducing work-family conflict, suffice it to say that it is in the interest of society as a whole to be invested in a next generation of citizens, even if only, as Goodin puts it, "to engage in productive labor in order to support us in our old age."

Table 4 also reveals that, except for physical activity, the percentage reduction in out-of-home time investments in the remaining non-work activities is more substantially impacted (due the presence of a young child) than the corresponding in-home time investments. This finding supports one of the motivations of this study, which was to differentiate between in-home and out-of-home activities. Almost all previous studies of time-use and social exclusion have not made this distinction between in-home and out-of-home locations, but our study shows a higher impact on mobility-related social exclusion relative to general time-use social exclusion. This finding is also quite intuitive, since a time crunch should more adversely affect out-of-home activity participation (because of the additional travel time involved in such activity) than in-home activity participation. At the same time, this result brings up the issue of designing for good out-of-home activity accessibility to acknowledge that mobility-related social exclusion is a combination of "the time crunch" and the spatial accessibility of out-of-home activity

locations (see also Paez *et al.*, 2010 and Farber *et al.*, 2011). For example, the promotion of mixed land-use developments would cut down on travel times to partake in out-of-home activity participations, and can contribute to a reduction in mobility-related social exclusion, in addition to the more traditional motivations attributed to such developments (such as increasing non-motorized use and reducing motorized travel, enhancing social vibrancy, and reducing traffic congestion, energy dependence, and air pollution).

Two other observations from Table 4 are noteworthy. First, there are differences in the elasticity effects across activity purposes. The largest time investment decrease due to the presence of a young child is in in-home physical activity, followed by out-of-home recreational activity and maintenance activity. There are also substantial (and statistically significant) decreases in time investments in out-of-home social, in-home recreational, out-of-home physical, and out-of-home eat activities, clearly demonstrating time poverty effects in the presence of young children as in earlier studies (Nomaguchi, 2009, Voorpostel *et al.*, 2010). The lower (and statistically insignificant) elasticity for travel activity is likely a result of increased travel for out-of-home child-care activities (such as dropping and picking up children at day care centers) and shopping activities, making up for some of the reduction in other out-of-home activities. Second, the negative elasticity values for all non-shop alternatives are higher for women compared to men, consistent with the finding of previous studies that the time crunch in dual-earner couples disproportionately affects women (Deding and Lausten, 2011, Leonard, 2001, Nomaguchi *et al.*, 2005). This disproportionate effect is particularly high in in-home maintenance, in-home social, in-home eating, and personal care activities, and in out-of-home physical and eating activities. Overall, the results suggest that there is a significant struggle for dual-earner couples to allocate their time among work, childcare, and all other activities, leading to a heightened sense of work-family conflict by creating time poverty conditions and social exclusion problems, more so for women than men.[11]

[11] It may be surprising to find in Table 4 that the elasticity effect for men in families with young children is higher than for women, given that the results from Table 2 indicate that women are more likely than men to participate in shopping and also partake in these activities for longer durations. But the values in Table 4 are elasticity effects, and while the overall duration of shopping time increase is higher for women than for

CHAPTER 5: CONCLUSIONS

This research study has undertaken an empirical investigation into the time use patterns of employed adults in dual-earner households with and without children, while controlling for a range of other individual and household socio-demographic characteristics. The study used a disaggregate activity purpose classification and examined time-use in both in-home and out-of-home activity pursuits, with the objective of contributing to time-use analysis and transportation studies, as well as to the social science literature through a study of time poverty and social exclusion considerations. The methodology used for the analysis explicitly and appropriately recognizes the multiple discrete nature of activity participation (*i.e.*, individuals can participate in multiple activity purpose-location alternatives) and the time invested in the chosen activity alternatives.

The empirical results from the multiple discrete-continuous nested extreme value (MDCNEV) model used in the analysis offer several insights into the determinants of activity time-use decisions in dual-earner households. First, a number of demographic factors (including age, race/ethnicity, employment sector, and immigration status) that have not been extensively examined in the earlier social science literature are found to influence the time-use patterns of dual-earner households. These findings highlight the importance of going beyond simple descriptive time-use analyses of the effects of one or two variables to adopting multivariate models systems that simultaneously examine the effects of multiple variables. In addition, our analysis reveals the interaction effects of such variables as age, gender, and presence of children on time-use patterns, another reason for examining the effects of multiple variables jointly. Second, there are differences in the impacts of variables (including presence of children) by activity purpose and by location of activity performance, suggesting that studies that use aggregate activity purposes and/or ignore the location of activity performance (in-home or out-of-home) are subject to aggregation bias and the resulting ecological fallacy

men (within families with young children relative to families with no young children), the percentage increase is higher for men relative to women.

fallouts, and also mask variations in time poverty and social exclusion by activity purpose/location. For instance, our analysis shows that, in general, the presence of a child leads to a substantially larger decrease in out-of-home activity participation, suggesting a higher level of mobility-related social exclusion relative to overall time-use social exclusion. This finding has a bearing on urban planning and transportation accessibility, and supports the notion that land-use policies can be used as instruments to address time poverty and social exclusion (inclusion) issues. Third, our results reinforce the results from earlier studies (Bianchi, 2009, Ekert-Jaffe 2011, Deding and Lausten 2011) that individuals, and particularly women, in dual-earner households with children face a substantial work-family conflict situation, suggesting the need to rigorously evaluate and consider the implementation of work-friendly policies such as paid maternity and paternity leave, paid sick days, proportional wages for part-time work, flexible work scheduling, and related government policies (see, for example, Lesnard, 2008 and Goodin, 2010). Policies that promote physical activity and or provide recreational opportunities at the work place may also be beneficial in addressing time poverty and social exclusion considerations. At the same time, doing so may also be advantageous to employers because of a potential increase in job satisfaction and improved work productivity (see, for example, Choi 2009). Additionally, Forsberg (2009) observed the tendency of working parents to utilize time management strategies such as delegating, alternating, and multitasking as a way to feel more involved in their home lives. Thus, educational/support programs that provide training to employees on time management strategies and schedule coordination may help alleviate time poverty and social exclusion problems in dual-earner households. Overall, company policies designed to provide a sense of empowerment to employees to take care of personal and family situations can help instill a stronger sense of work-family balance (Wong and Ko, 2009).

From an activity-based travel modeling perspective, the time use model developed in this study underscores the need to consider a host of demographic variables and their interactions when modeling activity participation and time-use decisions. Further, analysts would do well to consider different household segment groups such as

dual earner households with children, rather than estimating models by pooling all households. From a practical standpoint, most activity-based (AB) travel demand models follow a two-step process for determining travel patterns, with the first activity generation step determining daily activity participation decisions of all members in each household in the study region. In the second step, the AB travel simulator schedules these activities during available time slots of each individual. The time-use model developed in this study can be incorporated into the first activity generation step of AB demand models.

Of course, as with any research effort, there are several limitations inherent in the current study. First, and probably most important, the time use patterns under study correspond to observed patterns, not to desired patterns. Thus, while we have invoked the issues of time poverty and social exclusion in several places in this study, it can be just as well that, for example, the decrease in out-of-home recreation participation due to the presence of a child is a deliberate and desired choice of the individual (as opposed to arising from time poverty or leading to social exclusion). To tease out the difference between deliberate choices and constraint-driven patterns, one needs information on what the respondent would have liked to do but is unable to, in addition to the observed time-use patterns. This would provide a measure of unfulfilled demand. Unfortunately, such data is not available in typical time-use and activity diary data. The implicit assumption in our analysis is that time-use patterns associated with lower intensities of participation in non-work and non-child care activities are indicative of time poverty and social exclusion. Future research needs to develop better measures of time poverty and social exclusion, and formulate instruments to collect such measures through both quantitative as well as qualitative surveys. Qualitative surveys can also shed light on the underlying reasons for the effects of variables, such as those associated with race and immigration status. Second, the current study analyzes time use at the individual level without considering the social context of activity involvement. In this regard, a household level analysis of time use patterns is more appropriate (for example, see Bhat *et al.*, 2012 and Barnett *et al.*, 2009). For example, individuals in families with children might not be able

to participate in recreational activities alone as much as they used to before they had a child, but may enjoy the recreation activities they pursue with the child even more than what they used to pursue alone. So, it is possible that their overall well-being is not affected negatively due to the presence of children. Unfortunately, the ATUS data used in this research does not provide information on the social context of activity participation. Third, the analysis in this study is based on a single day of data, which may not reflect the time use patterns over longer and more stable periods of time such as a week or even multi-week periods.

To summarize, efforts to obtain desired as well as observed household time-use patterns through both quantitative and qualitative surveys, and over extended periods of time, should be a priority area for undertaking time-use research and associated time poverty and social exclusion research.

APPENDIX

Table 1: Descriptive Analysis of Activity Participation and Daily Time Investment

Activity Purpose	Location	% of Respondents Participating in the Activity Purpose-Location Alternative		Mean Duration of Participation Among Respondents Participating in the Activity Purpose-Location Alternative (in minutes)	
		Households without Children	Households with Children	Households without Children	Households with Children
Work	In-home	21.55	19.23	136.74	142.58
	Out-of-home	58.62	60.34	489.29	478.62
Child Care	In-home	0.00	66.66	--	98.93
	Out-of-home	0.00	42.05	--	47.86
Maintenance	In-home	75.59	78.45	125.03	130.25
	Out-of-home	26.58	21.39	75.40	54.17
Social	In-home	23.23	23.72	77.25	73.61
	Out-of-home	28.04	26.65	153.43	128.30
Recreation	In-home	87.59	83.43	216.72	168.44
	Out-of-home	20.43	19.55	87.81	71.64
Physical	In-home	7.97	4.52	54.11	68.27
	Out-of-home	12.89	13.06	112.62	97.68
Eat & Drink	In-home	81.70	79.32	47.59	47.21
	Out-of-home	57.99	55.33	53.48	51.61
Shopping	Out-of-home	37.17	41.76	52.40	54.16
Travel	Out-of-home	91.83	95.25	85.89	82.77
Personal Care	In-home	100.00	100.00	553.35	534.46

Table 2: MDCNEV Estimation Results: Baseline Utility

Alternative		Household Socio-demographics					
		Presence of Children					
Activity Purpose	**Location**	0-5 years	6-10 years	11-15 years	Female ≤ 30 years with Children	Female 31-45 years with Children	Female ≥ 46 years with Children
Work	In-home	--	-0.3090 (-2.33)	-0.3090 (-2.33)	--	--	--
	Out-of-home	--	--	--	--	--	--
Child Care	In-home	0.5199 (3.87)	--	-0.6573 (-4.67)	0.8058 (4.50)	0.6530 (5.30)	--
	Out-of-home	--	--	--	0.2610 (4.00)	0.2610 (4.00)	0.2610 (4.00)
Maintenance	In-home	--	--	--	--	--	--
	Out-of-home	-0.0807 (-2.93)	-0.0807 (-2.93)	-0.0807 (-2.93)	--	--	--
Social	In-home	--	--	--	--	--	--
	Out-of-home	-0.0807 (-2.93)	-0.0807 (-2.93)	-0.0807 (-2.93)	--	--	--
Recreation	In-home	-0.2980 (-4.14)	-0.2287 (-2.71)	--	--	--	--
	Out-of-home	-0.0807 (-2.93)	-0.0807 (-2.93)	-0.0807 (-2.93)	--	--	--
Physical	In-home	-0.9657 (-3.22)	--	--	--	--	--
	Out-of-home	-0.0807 (-2.93)	-0.0807 (-2.93)	-0.0807 (-2.93)	--	--	--
Eat & Drink	In-home	--	--	--	--	--	--
	Out-of-home	-0.0807 (-2.93)	-0.0807 (-2.93)	-0.0807 (-2.93)	--	--	--
Shop	Out-of-home	0.1088 (2.27)	--	--	--	--	--
Travel	Out-of-home	--	--	--	--	--	--

Table 2: MDCNEV Estimation Results: Baseline Utility (Continued)

Alternative		Household Socio-demographics		Respondent Socio-demographics			
Activity Purpose	**Location**	*Resides in Metropolitan Region*	*Geographic Location*	*Age and Gender (Base Category is Male ≤ 45 years)*			
			South	Male >45 years	Female ≤ 30 years	Female 31-45 years	
Work	In-home	--	--	--	--	--	--
	Out-of-home	--	--	--	-0.1850 (-4.33)	-0.1850 (-4.33)	-0.1850 (-4.33)
Child Care	In-home	--	--	--	--	--	--
	Out-of-home	--	--	--	--	--	--
Maintenance	In-home	--	--	--	0.6094 (9.18)	0.6094 (9.18)	0.6094 (9.18)
	Out-of-home	--	--	--	0.2811 (5.22)	0.2811 (5.22)	0.2811 (5.22)
Social	In-home	--	--	--	--	--	--
	Out-of-home	-0.1433 (-2.27)	--	--	0.4862 (6.62)	0.1901 (3.38)	0.1901 (3.38)
Recreation	In-home	--	--	--	-0.2273 (-3.51)	-0.2273 (-3.51)	-0.2273 (-3.51)
	Out-of-home	--	--	--	--	--	--
Physical	In-home	--	-0.8898 (-3.72)	-0.8061 (-3.16)	-0.6373 (-3.93)	-0.6373 (-3.93)	-0.6373 (-3.93)
	Out-of-home	--	--	--	-0.1132 (-1.59)	-0.1132 (-1.59)	-0.1132 (-1.59)
Eat	In-home	--	--	0.7213 (7.78)	--	--	--
	Out-of-home	--	0.2072 (5.62)	--	0.3332 (6.06)	--	--
Shop	Out-of-home	--	--	--	0.2263 (4.97)	0.2263 (4.97)	0.2263 (4.97)
Travel	Out-of-home	--	--	--	--	--	--

Table 2: MDCNEV Estimation Results: Baseline Utility (Continued)

Alternative		Respondent Socio-demographics					
		Race (Base Category comprises of All Other Races)		*Ethnicity (Base Category is Non-Hispanic)*	*Educational Attainment (Base Category is High School or Below)*		
Activity Purpose	**Location**	Caucasian	African American	Hispanic	Associate Degree	Bachelor Degree	Masters or PhD Degree
Work	In-home	--	--	-0.7873 (-2.97)	--	--	--
	Out-of-home	--	--	--	--	-0.1153 (-3.36)	-0.1153 (-3.36)
Child Care	In-home	-0.4007 (-2.18)	-0.9586 (-3.81)	-0.4136 (-2.94)	--	--	--
	Out-of-home	--	--	--	--	--	--
Maintenance	In-home	--	-0.5290 (-3.70)	--	--	--	--
	Out-of-home	--	--	--	--	--	--
Social	In-home	--	--	--	--	--	--
	Out-of-home	--	--	--	--	--	--
Recreation	In-home	--	--	--	-0.3844 (-5.27)	-0.3844 (-5.27)	-0.5627 (-6.25)
	Out-of-home	--	--	--	--	--	-0.2383 (-2.98)
Physical	In-home	--	--	--	--	--	--
	Out-of-home	--	--	--	--	--	--
Eat	In-home	-0.4671 (-3.17)	-0.8070 (-4.13)	--	--	--	--
	Out-of-home	--	-0.2880 (-3.18)	--	--	--	-0.0950 (-2.09)
Shop	Out-of-home	--	--	--	--	--	--
Travel	Out-of-home	--	--	--	--	--	--

Table 2: MDCNEV Estimation Results: Baseline Utility (Continued)

Alternative		**Respondent Socio-demographics**					
		Employment Characteristics				*Immigration Status (Base category is U.S. Born)*	
Activity Purpose	**Location**	Holds Multiple jobs (*versus* Single job)	*Employment Industry (Base category comprises of all other industry types)*				
			Construction	Finance	Armed Forces	Foreign born citizen	Foreign born non-citizen
Work	In-home	0.7257 (4.63)	-1.2302 (-2.67)	-0.5588 (-2.10)	-0.6582 (-2.77)	--	--
	Out-of-home	--	--	--	--	--	--
Child Care	In-home	--	--	--	--	--	--
	Out-of-home	--	--	--	--	--	--
Maintenance	In-home	--	--	--	--	--	--
	Out-of-home	--	--	--	--	--	--
Social	In-home	--	--	--	--	--	--
	Out-of-home	--	--	--	--	-0.1843 (-2.42)	-0.1843 (-2.42)
Recreation	In-home	--	--	--	--	--	-0.3135 (-2.87)
	Out-of-home	--	--	--	--	--	--
Physical	In-home	--	--	--	--	--	--
	Out-of-home	--	--	--	--	--	-0.3092 (-2.14)
Eat	In-home	--	--	--	--	--	--
	Out-of-home	--	--	--	--	--	--
Shop	Out-of-home	--	--	--	--	--	--
Travel	Out-of-home	--	--	--	--	--	--

Table 2: MDCNEV Estimation Results: Baseline Utility (Continued)

Alternative		**Couple Characteristics**					**Day of Week (Base Category is Weekday)**	**Baseline Constant**
Activity Purpose	**Location**	Spouse Education (Base category is High School or Below) / Beyond High School	Both Man and Woman are Hispanic	Young Couple (*i.e.*, Both Man and Woman aged ≤ 30 years)	Absolute Age Difference	Respondent Earns Less Than spouse	Weekend	
Work	In-home	0.6293 (4.59)	-0.5234 (-2.76)	--	-0.0356 (-1.94)	-0.2435 (-2.38)	-0.5758 (-3.83)	-6.5027 (-32.18)
	Out-of-home	--	--	--	--	--	-1.4109 (-19.62)	-5.8408 (-69.77)
Child Care	In-home	--	--	--	--	--	-0.6086 (-4.19)	-5.5915 (-24.27)
	Out-of-home	--	--	--	--	--	-0.7290 (-7.71)	-6.5387 (-65.33)
Maintenance	In-home	--	--	-0.1556 (-2.34)	--	--	--	-5.7399 (-77.71)
	Out-of-home	--	--	--	--	--	-0.4200 (-6.01)	-6.9774 (-71.70)
Social	In-home	--	--	--	--	--	--	-7.5439 (-96.62)
	Out-of-home	--	--	--	--	--	--	-7.0628 (-53.04)
Recreation	In-home	--	--	--	--	--	--	-4.6511 (-47.45)
	Out-of-home	--	--	--	--	--	-0.4373 (-5.87)	-6.8833 (-70.95)
Physical	In-home	--	--	--	--	--	--	-8.1435 (-55.74)
	Out-of-home	--	--	--	--	--	-0.3981 (-4.55)	-7.0519 (-39.04)
Eat	In-home	--	--	--	--	--	--	-5.0453 (-31.60)
	Out-of-home	--	--	--	--	--	-0.5180 (-10.51)	-6.1559 (-71.31)
Shop	Out-of-home	--	--	--	--	--	--	-6.8031 (-72.91)
Travel	Out-of-home	--	--	--	--	--	-0.5080 (-11.09)	-4.8207 (-68.46)

Table 3: MDCNEV Estimation Results: Translation Parameters

Alternative		Constant	Age and Gender (Base category is Female between 31 and 45 years and Male <= 30 years)				Presence of Children	
Activity Purpose	**Location**		Female ≤ 30 years	Female ≥ 46 years	Male 31 to 45 years	Male ≥ 46 years	Male with children	Female with children
Work	In-home	4.125 (34.35)	-0.929 (-3.61)	--	--	0.5580 (2.28)	--	--
	Out-of-home	6.5502 (64.02)	--	--	--	--	--	--
Child Care	In-home	3.2495 (27.99)	--	--	--	--	--	--
	Out-of-home	3.5721 (43.58)	--	0.6337 (2.14)	--	--	--	--
Maintenance	In-home	3.3082 (55.85)	--	--	--	--	--	--
	Out-of-home	4.2428 (49.04)	--	--	--	--	--	-0.3641 (-2.30)
Social	In-home	3.7095 (32.64)	--	--	--	--	--	--
	Out-of-home	5.3047 (52.23)	--	--	-0.3019 (-1.83)	-0.3019 (-1.83)	--	--
Recreation	In-home	3.6805 (51.32)	--	--	--	--	--	--
	Out-of-home	4.7196 (42.03)	--	--	--	-0.3728 (-1.86)	-0.3985 (-2.14)	--
Physical	In-home	3.8086 (11.36)	--	--	--	--	--	--
	Out-of-home	5.1355 (34.53)	--	--	--	--	--	--
Eat	In-home	2.5786 (29.10)	--	--	--	-0.4267 (-2.26)	--	--
	Out-of-home	3.8948 (51.32)	--	--	--	--	--	--
Shop	Out-of-home	3.9311 (51.65)	--	0.2448 (1.64)	--	--	--	--
Travel	Out-of-home	2.9628 (44.45)	--	--	--	--	--	--

Table 4: Elasticity Effects of Presence of Children 5 years or younger

Activity Purpose	Location	All		Men		Women	
		Elasticity	T-Stat	Elasticity	T-Stat	Elasticity	T-Stat
Work	In-home	-1.05	-0.43	1.37	0.62	-3.91	-1.40
	Out-of-home	-4.12	-1.70	-1.46	-0.68	-7.40	-2.57
Maintenance	In-home	-3.63	-1.85	-1.12	-0.65	-5.01	-2.35
	Out-of-home	-38.69	-4.37	-36.57	-4.00	-39.88	-4.59
Social	In-home	-3.37	-1.61	-1.01	-0.54	-5.55	-2.35
	Out-of-home	-16.90	-4.76	-16.81	-4.54	-16.96	-4.67
Recreation	In-home	-24.78	-5.73	-23.10	-5.40	-26.68	-6.05
	Out-of-home	-39.98	-3.72	-38.11	-3.41	-41.54	-3.98
Physical	In-home	-59.00	-4.96	-58.27	-4.81	-60.07	-5.18
	Out-of-home	-15.62	-3.98	-13.18	-3.40	-18.46	-4.65
Eat	In-home	-3.14	-1.65	-1.08	-0.66	-5.27	-2.40
	Out-of-home	-14.26	-4.15	-11.77	-3.44	-16.32	-4.67
Shop	Out-of-home	16.05	1.89	20.27	2.31	13.48	1.63
Travel	Out-of-home	-2.50	-1.33	-0.35	-0.21	-4.48	-2.10
Personal Care	In-home	-2.41	-1.63	-0.74	-0.58	-3.94	-2.32

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